

In the Claims:

1. (Currently Amended) A chemical sensor that senses a chemical, comprising:
a flexible substrate;
a flexible lower electrode on the flexible substrate;
a patterned flexible dielectric layer on the flexible lower electrode opposite the flexible substrate; and

a patterned flexible upper electrode on the patterned flexible dielectric layer opposite the flexible lower electrode, the patterned flexible dielectric layer and the patterned flexible upper electrode being patterned to provide at least one opening that exposes the flexible lower electrode to the chemical, if present, and to establish a current flow path between the flexible lower electrode and the patterned flexible upper electrode through the chemical, if present, upon application of voltage between the flexible lower electrode and the patterned flexible upper electrode.

2. (Currently Amended) ~~A chemical sensor according to Claim 1~~
A chemical sensor that senses a chemical, comprising:
a flexible substrate;
a flexible lower electrode on the flexible substrate;
a patterned flexible dielectric layer on the flexible lower electrode opposite the flexible substrate; and
a patterned flexible upper electrode on the patterned flexible dielectric layer opposite the flexible lower electrode, the patterned flexible dielectric layer and the patterned flexible upper electrode being patterned to establish a current flow path between the flexible lower electrode and the patterned flexible upper electrode through the chemical, if present, upon application of voltage between the flexible lower electrode and the patterned flexible upper electrode;

wherein the patterned flexible upper electrode includes a plurality of spaced apart fingers that are spaced apart from one another by at least an order of magnitude more than the thickness of the patterned flexible dielectric layer.

3. (Currently Amended) A chemical sensor according to Claim ~~[[1]]~~ 2 wherein the patterned flexible dielectric layer is between about one quarter micron and about two

microns thick and wherein adjacent fingers in the plurality of spaced apart fingers are spaced apart from one another by about five microns to about fifty microns.

4. (Currently Amended) ~~A chemical sensor according to Claim 1~~

A chemical sensor that senses a chemical, comprising:

a flexible substrate;

a flexible lower electrode on the flexible substrate;

a patterned flexible dielectric layer on the flexible lower electrode opposite the flexible substrate; and

a patterned flexible upper electrode on the patterned flexible dielectric layer opposite the flexible lower electrode, the patterned flexible dielectric layer and the patterned flexible upper electrode being patterned to establish a current flow path between the flexible lower electrode and the patterned flexible upper electrode through the chemical, if present, upon application of voltage between the flexible lower electrode and the patterned flexible upper electrode;

wherein the flexible lower electrode is an unpatterned flexible lower electrode.

5. (Currently Amended) ~~A chemical sensor according to Claim 1~~

A chemical sensor that senses a chemical, comprising:

a flexible substrate;

a flexible lower electrode on the flexible substrate;

a patterned flexible dielectric layer on the flexible lower electrode opposite the flexible substrate; and

a patterned flexible upper electrode on the patterned flexible dielectric layer opposite the flexible lower electrode, the patterned flexible dielectric layer and the patterned flexible upper electrode being patterned to establish a current flow path between the flexible lower electrode and the patterned flexible upper electrode through the chemical, if present, upon application of voltage between the flexible lower electrode and the patterned flexible upper electrode;

wherein the flexible substrate comprises polyimide.

6. (Currently Amended) ~~A chemical sensor according to Claim 1~~

A chemical sensor that senses a chemical, comprising:
a flexible substrate;
a flexible lower electrode on the flexible substrate;
a patterned flexible dielectric layer on the flexible lower electrode opposite the
flexible substrate; and
a patterned flexible upper electrode on the patterned flexible dielectric layer opposite
the flexible lower electrode, the patterned flexible dielectric layer and the patterned flexible
upper electrode being patterned to establish a current flow path between the flexible lower
electrode and the patterned flexible upper electrode through the chemical, if present, upon
application of voltage between the flexible lower electrode and the patterned flexible upper
electrode;
wherein the flexible dielectric layer comprises polyimide, a Plasma Enhanced
Chemical Vapor Deposition (PECVD) coating and/or a Diamond-Like Carbon (DLC)
coating.

7. (Original) A chemical sensor according to Claim 1 wherein the flexible lower electrode and the patterned flexible upper electrode each comprises gold, platinum, palladium and/or copper.

8. (Original) A chemical sensor according to Claim 1 wherein the substrate includes a substrate face, wherein the flexible lower electrode is on the substrate face and wherein the current flow path extends at least partially along a direction that is nonparallel to the substrate face.

9. (Original) A chemical sensor according to Claim 1 wherein the substrate includes a substrate face, wherein the flexible lower electrode is on the substrate face and wherein the current flow path extends at least partially along a direction that is orthogonal to the substrate face.

10. (Original) A chemical sensor according to Claim 1 wherein the flexible lower electrode is a patterned flexible lower electrode.

11. (Currently Amended) ~~A chemical sensor according to Claim 10~~

A chemical sensor that senses a chemical, comprising:

a flexible substrate;

a patterned flexible lower electrode on the flexible substrate;

a patterned flexible dielectric layer on the patterned flexible lower electrode opposite the flexible substrate; and

a patterned flexible upper electrode on the patterned flexible dielectric layer opposite the patterned flexible lower electrode, the patterned flexible dielectric layer and the patterned flexible upper electrode being patterned to establish a current flow path between the patterned flexible lower electrode and the patterned flexible upper electrode through the chemical, if present, upon application of voltage between the patterned flexible lower electrode and the patterned flexible upper electrode;

wherein the patterned flexible lower electrode is patterned to establish a second current flow path between portions of the patterned flexible lower electrode through the chemical, if present, upon application of voltage between the portions of the patterned flexible lower electrode.

12. (Original) A chemical sensor according to Claim 11 wherein the patterned flexible upper electrode is patterned to establish a third current flow path between portions of the patterned flexible upper electrode through the chemical, if present, upon application of voltage between the portions of the patterned flexible upper electrode.

13. (Currently Amended) ~~A chemical sensor according to Claim 1~~

A chemical sensor that senses a chemical, comprising:

a flexible substrate;

a flexible lower electrode on the flexible substrate;

a patterned flexible dielectric layer on the flexible lower electrode opposite the flexible substrate; and

a patterned flexible upper electrode on the patterned flexible dielectric layer opposite the flexible lower electrode, the patterned flexible dielectric layer and the patterned flexible upper electrode being patterned to establish a current flow path between the flexible lower electrode and the patterned flexible upper electrode through the chemical, if present, upon

application of voltage between the flexible lower electrode and the patterned flexible upper electrode;

wherein the patterned flexible upper electrode is patterned to establish a second current flow path between portions of the patterned flexible upper electrode through the chemical, if present, upon application of voltage between the portions of the patterned flexible upper electrode.

14. (Currently Amended) ~~A chemical sensor according to Claim 10~~

A chemical sensor that senses a chemical, comprising:

a flexible substrate;

a patterned flexible lower electrode on the flexible substrate;

a patterned flexible dielectric layer on the patterned flexible lower electrode opposite the flexible substrate; and

a patterned flexible upper electrode on the patterned flexible dielectric layer opposite the patterned flexible lower electrode, the patterned flexible dielectric layer and the patterned flexible upper electrode being patterned to establish a current flow path between the patterned flexible lower electrode and the patterned flexible upper electrode through the chemical, if present, upon application of voltage between the patterned flexible lower electrode and the patterned flexible upper electrode;

wherein the patterned flexible upper electrode and the patterned flexible lower electrode both include a plurality of spaced apart fingers, the patterned flexible dielectric layer, the patterned flexible lower electrode and the patterned flexible upper electrode being patterned to establish a first current flow path between the patterned flexible lower electrode and the patterned flexible upper electrode through the chemical, if present, a second current flow path between adjacent fingers of the patterned flexible lower electrode through the chemical, if present, and a third current flow path between adjacent fingers of the patterned flexible upper electrode through the chemical, if present, upon application of voltage between the adjacent fingers of the patterned flexible lower electrode, between the adjacent fingers of the patterned flexible upper electrode and between adjacent fingers of the patterned upper and lower flexible electrodes.

15. (Currently Amended) ~~A chemical sensor according to Claim 10~~

A chemical sensor that senses a chemical, comprising:
a flexible substrate;
a patterned flexible lower electrode on the flexible substrate;
a patterned flexible dielectric layer on the patterned flexible lower electrode opposite
the flexible substrate; and

a patterned flexible upper electrode on the patterned flexible dielectric layer opposite
the patterned flexible lower electrode, the patterned flexible dielectric layer and the patterned
flexible upper electrode being patterned to establish a current flow path between the patterned
flexible lower electrode and the patterned flexible upper electrode through the chemical, if
present, upon application of voltage between the patterned flexible lower electrode and the
patterned flexible upper electrode;

wherein the patterned flexible dielectric layer, the patterned flexible lower electrode and the patterned flexible upper electrode are patterned to establish a first current flow path between the patterned flexible lower electrode and the patterned flexible upper electrode through the chemical, if present, a second current flow path between portions of the patterned flexible lower electrode through the chemical, if present, and a third current flow path between portions of the patterned flexible upper electrode through the chemical, if present, upon application of voltage between the patterned flexible upper electrode and the patterned flexible lower electrode.

16. (Original) A chemical sensor that senses a chemical, comprising:
a substrate;
a lower electrode on the substrate;
a patterned dielectric layer on the lower electrode opposite the substrate; and
a patterned upper electrode on the patterned dielectric layer opposite the lower electrode, the patterned dielectric layer and the patterned upper electrode being patterned to establish a first current flow path between the lower electrode and the patterned upper electrode through the chemical, if present, upon application of voltage between the lower electrode and the patterned upper electrode and to establish a second current flow path between portions of the patterned upper electrode through the chemical, if present, upon application of voltage between the portions of the patterned upper electrode.

17. (Currently Amended) ~~A chemical sensor according to Claim 16~~
A chemical sensor that senses a chemical, comprising:
a substrate;
a lower electrode on the substrate;
a patterned dielectric layer on the lower electrode opposite the substrate; and
a patterned upper electrode on the patterned dielectric layer opposite the lower
electrode, the patterned dielectric layer and the patterned upper electrode being patterned to
establish a first current flow path between the lower electrode and the patterned upper
electrode through the chemical, if present, upon application of voltage between the lower
electrode and the patterned upper electrode and to establish a second current flow path
between portions of the patterned upper electrode through the chemical, if present, upon
application of voltage between the portions of the patterned upper electrode;
wherein the lower electrode is an unpatterned lower electrode.

18. (Original) A chemical sensor according to Claim 16 wherein the substrate includes a substrate face, wherein the lower electrode is on the substrate face and wherein the first current flow path extends at least partially along a direction that is nonparallel to the substrate face.

19. (Original) A chemical sensor according to Claim 16 wherein the substrate includes a substrate face, wherein the lower electrode is on the substrate face and wherein the first current flow path extends at least partially along a direction that is orthogonal to the substrate face.

20. (Currently Amended) ~~A chemical sensor according to Claim 16~~
A chemical sensor that senses a chemical, comprising:
a substrate;
a lower electrode on the substrate;
a patterned dielectric layer on the lower electrode opposite the substrate; and
a patterned upper electrode on the patterned dielectric layer opposite the lower
electrode, the patterned dielectric layer and the patterned upper electrode being patterned to
establish a first current flow path between the lower electrode and the patterned upper

electrode through the chemical, if present, upon application of voltage between the lower electrode and the patterned upper electrode and to establish a second current flow path between portions of the patterned upper electrode through the chemical, if present, upon application of voltage between the portions of the patterned upper electrode;

wherein the patterned upper electrode includes a plurality of spaced apart fingers, the patterned dielectric layer and the patterned upper electrode being patterned to establish the first current flow path between the lower electrode and the patterned upper electrode through the chemical, if present, and the second current flow path between adjacent fingers of the patterned upper electrode through the chemical, if present, upon application of voltage between adjacent fingers of the patterned upper electrode and between the fingers of the patterned upper electrode and the lower electrode.

21. (Original) A chemical sensor according to Claim 16 wherein the lower electrode is a patterned lower electrode.

22. (Original) A chemical sensor according to Claim 21 wherein the patterned lower electrode is patterned to establish a third current flow path between portions of the patterned lower electrode through the chemical, if present, upon application of voltage between the portions of the flexible lower electrode.

23. (Currently Amended) ~~A chemical sensor according to Claim 21~~
A chemical sensor that senses a chemical, comprising:
a substrate;
a patterned lower electrode on the substrate;
a patterned dielectric layer on the patterned lower electrode opposite the substrate;
and
a patterned upper electrode on the patterned dielectric layer opposite the patterned lower electrode, the patterned dielectric layer and the patterned upper electrode being patterned to establish a first current flow path between the patterned lower electrode and the patterned upper electrode through the chemical, if present, upon application of voltage between the patterned lower electrode and the patterned upper electrode and to establish a second current flow path between portions of the patterned upper electrode through the

chemical, if present, upon application of voltage between the portions of the patterned upper electrode;

wherein the patterned upper electrode and the patterned lower electrode both include a plurality of spaced apart fingers, the patterned dielectric layer, the patterned lower electrode and the patterned upper electrode being patterned to establish the first current flow path between the patterned lower electrode and the patterned upper electrode through the chemical, if present, the second current flow path between adjacent fingers of the patterned upper electrode through the chemical, if present, and a third current flow path between adjacent fingers of the patterned lower electrode through the chemical, if present, upon application of voltage between the adjacent fingers of the patterned lower electrode, between adjacent fingers of the patterned upper electrode and between adjacent fingers of the patterned upper and lower electrodes.

24. (Currently Amended) A chemical sensor that senses a chemical, comprising:
a substrate;

a lower electrode on the substrate;

an upper electrode on the lower electrode opposite the substrate and spaced apart from the lower electrode; and

means for establishing a first current flow path between the lower electrode and the upper electrode through the chemical, if present, upon application of voltage between the lower electrode and the upper electrode and for establishing a second current flow path between portions of the ~~patterned~~ upper electrode through the chemical, if present, upon application of voltage between the portions of the upper electrode.

25. (Original) A chemical sensor according to Claim 24 wherein the substrate includes a substrate face, wherein the lower electrode is on the substrate face and wherein the first current flow path extends at least partially along a direction that is nonparallel to the substrate face.

26. (Original) A chemical sensor according to Claim 24 wherein the substrate includes a substrate face, wherein the lower electrode is on the substrate face and wherein the

first current flow path extends at least partially along a direction that is orthogonal to the substrate face.

27. (Original) A chemical sensor according to Claim 24 wherein the means for establishing further comprises means for establishing a third current flow path between portions of the lower electrode through the chemical, if present, upon application of voltage between the portions of the lower electrode.

28. (Original) A method of fabricating a chemical sensor that senses a chemical, comprising:

forming a flexible lower electrode on a flexible substrate;

forming a flexible dielectric layer on the flexible lower electrode opposite the flexible substrate;

forming a patterned flexible upper electrode on the flexible dielectric layer opposite the flexible lower electrode; and

patterning the flexible dielectric layer using the patterned flexible upper electrode as a mask to establish a current flow path between the flexible lower electrode and the patterned flexible upper electrode through the chemical, if present, upon application of voltage between the flexible lower electrode and the patterned flexible upper electrode.

29. (Original) A method according to Claim 28 wherein the forming a patterned flexible upper electrode comprises forming a patterned flexible upper electrode that includes a plurality of spaced apart fingers that are spaced apart from one another by at least an order of magnitude more than the thickness of the flexible dielectric layer.

30. (Original) A method according to Claim 28 wherein the flexible substrate comprises polyimide.

31. (Original) A method according to Claim 28 wherein the flexible dielectric layer comprises polyimide, a Plasma Enhanced Chemical Vapor Deposition (PECVD) coating and/or a Diamond-Like Carbon (DLC) coating.

32. (Original) A method according to Claim 28 wherein the flexible lower electrode and the patterned flexible upper electrode each comprises gold, platinum, palladium and/or copper.

33. (Original) A method according to Claim 28 wherein the forming a flexible lower electrode comprises forming a patterned flexible lower electrode on a flexible substrate.

34. (Original) A method according to Claim 28 wherein the following is performed between the forming a flexible lower electrode and the forming a flexible dielectric layer:

- laminating a flexible photoresist layer onto the flexible lower electrode;
- selectively exposing and developing the flexible photoresist layer; and
- patterning the flexible lower electrode using the flexible photoresist layer that has been exposed and developed as a mask; and

removing the flexible photoresist layer that has been exposed and developed from the flexible lower electrode layer that has been patterned.

35. (Original) A method according to Claim 28 wherein the forming a patterned flexible upper electrode comprises:

- forming a flexible upper electrode layer on the flexible dielectric layer;
- laminating a flexible photoresist layer onto the flexible upper electrode layer;
- selectively exposing and developing the flexible photoresist layer; and
- patterning the flexible upper electrode layer using the flexible photoresist layer that has been exposed and developed as a mask; and

removing the flexible photoresist layer that has been exposed and developed from the flexible upper electrode layer that has been patterned.

36. (Original) A method according to Claim 28 wherein the patterning the flexible dielectric layer comprises reactive ion etching the flexible dielectric layer using the patterned flexible upper electrode as a mask.

37. (Original) A method of fabricating a plurality of chemical sensors that sense a chemical, comprising:

forming a series of laterally spaced apart flexible lower electrodes on a flexible substrate;

forming a flexible dielectric layer on the series of laterally spaced apart flexible lower electrodes opposite the flexible substrate;

forming a series of patterned flexible upper electrodes on the dielectric layer, a respective one of which is opposite a respective one of the series of flexible lower electrodes; and

patterning the flexible dielectric layer using the series of patterned flexible upper electrodes as a mask to establish a current flow path between a respective flexible lower electrode and a respective patterned flexible upper electrode through the chemical, if present, upon application of voltage between the flexible lower electrode and the patterned flexible upper electrode.

38. (Original) A method according to Claim 37 wherein the forming a series of patterned flexible upper electrodes comprises forming a series of patterned flexible upper electrodes that each includes a plurality of spaced apart fingers that are spaced apart from one another by at least an order of magnitude more than the thickness of the flexible dielectric layer.

39. (Original) A method according to Claim 37 wherein the flexible substrate comprises polyimide.

40. (Original) A method according to Claim 37 wherein the flexible dielectric layer comprises polyimide, a Plasma Enhanced Chemical Vapor Deposition (PECVD) coating and/or a Diamond-Like Carbon (DLC) coating.

41. (Original) A method according to Claim 37 wherein the flexible lower electrode and the patterned flexible upper electrode each comprises gold, platinum, palladium and/or copper.

42. (Original) A method according to Claim 37 wherein the forming a series of laterally spaced apart flexible lower electrodes comprises:

- forming a flexible lower electrode layer on the flexible substrate;
- laminating a flexible photoresist layer onto the flexible lower electrode layer;
- selectively exposing and developing the flexible photoresist layer;
- patterning the flexible lower electrode layer using the flexible photoresist layer that has been exposed and developed as a mask; and
- removing the flexible photoresist layer that has been exposed and developed from the flexible lower electrode layer that has been patterned.

43. (Original) A method according to Claim 37 wherein the forming a series of patterned flexible upper electrodes on the dielectric layer comprises:

- forming a flexible upper electrode layer on the flexible dielectric layer;
- laminating a flexible photoresist layer onto the flexible upper electrode layer;
- selectively exposing and developing the flexible photoresist layer;
- patterning the flexible upper electrode layer using the flexible photoresist layer that has been exposed and developed as a mask; and
- removing the flexible photoresist layer that has been exposed and developed from the flexible upper electrode layer that has been patterned.

44. (Original) A method according to Claim 37 wherein the patterning the flexible dielectric layer comprises reactive ion etching the flexible dielectric layer using the series of patterned flexible upper electrodes as a mask.

45. (Original) A method of sensing a chemical using a chemical sensor that includes a substrate, a patterned lower electrode on the substrate, a patterned dielectric layer on the lower electrode opposite the substrate and a patterned upper electrode on the patterned dielectric layer opposite the lower electrode, the method comprising:

- applying voltage between adjacent portions of the patterned upper electrode, between adjacent portions of the patterned lower electrode and between adjacent portions of the patterned upper and lower electrodes, while the chemical sensor is potentially exposed to the chemical.

46. (Original) A method according to Claim 45 wherein the patterned upper electrode and the patterned lower electrode both include a plurality of spaced apart fingers, and wherein the applying comprises:

applying voltage between adjacent spaced apart fingers of the patterned upper electrode, between adjacent spaced apart fingers of the patterned lower electrode and between adjacent fingers of the patterned upper and lower electrodes, while the chemical sensor is potentially exposed to the chemical.